

WHAT IS CLAIMED IS:

- 1 1. A method for treating abnormal mucosa in an esophagus, said method
2 comprising:
3 positioning an energy delivery device within the esophagus; and
4 delivering energy from the device under conditions selected to initiate re-
5 growth of a mucosal layer without substantial injury to a submucosal layer underlying the
6 mucosal layer.
- 1 2. A method as in claim 1, wherein the energy is delivered at a total
2 dosage in the range from 1 J/cm² to 50 J/cm².
- 1 3. A method as in claim 2, wherein the total energy dosage is delivered
2 over a time period below 5 seconds.
- 1 4. A method as in any of claims 1 to 3, wherein the energy delivery
2 device is positioned in the lower esophagus.
- 1 5. A method as in claim 4, wherein the energy delivery device is
2 positioned to deliver energy to the entire circumferential mucosal surface over a length in the
3 range from 1 cm to 15 cm, the mucosal surface located above the lower esophageal sphincter.
- 1 6. A method as in claim 4, wherein the abnormal mucosa is metaplastic.
- 1 7. A method as in claim 4, wherein the energy is delivered over a
2 circumferential treatment region of the mucosa.
- 1 8. A method as in claim 7, wherein the energy is delivered about the
2 entire circumferential treatment region at one time.
- 1 9. A method as in claim 7, wherein the energy is delivered sequentially to
2 two or more segments of the circumferential treatment region.
- 1 10. A method as in claim 4, wherein the energy is delivered under
2 conditions which substantially necrose the mucosal layer.
- 1 11. A method as in claim 4, wherein the energy is delivered under
2 conditions which injure the mucosal layer without substantial necrosis.

1 12. A method as in claim 4, wherein the energy delivered comprises at
2 least one form of energy selected from the group consisting of radiofrequency energy,
3 thermal energy, microwave energy, ultrasonic energy, infrared and ultraviolet radiation.

1 13. A method as in claim 12, wherein the energy delivered comprises
2 radiofrequency energy.

1 14. A method as in claim 13, wherein delivering radiofrequency energy
2 comprises deploying an array of bipolar electrode pairs from the device.

1 15. A method as in claim 14, wherein the electrodes have a width in the
2 range from 0.1 mm to 3 mm and are spaced apart by a distance in the range from 0.1 mm to 3
3 mm.

1 16. A method as in claim 15 wherein the electrode pairs are formed over a
2 dimensionally stable membrane so that interelectrode spacing remains constant as the
3 membrane is deployed.

1 17. A method as in claim 14, wherein the electrode pairs directly contact
2 the mucosal surface.

1 18. A method as in claim 14, wherein the electrode pairs are on a side of
2 the membrane which does not directly contact the mucosal surface.

1 19. A method as in claim 13, wherein delivering the radiofrequency energy
2 comprises attaching one pole of a radiofrequency power supply to the device and another
3 pole to a counter electrode placed on the patient's body remote from the energy delivery
4 device.

1 20. A method as in claim 13, wherein the device comprises an expandable
2 bladder which is filled with a conductive fluid to deliver the radiofrequency energy through
3 the bladder.

1 21. A method as in claim 13, wherein the device comprises a monopolar
2 array in or over an expandable structure for delivering the radiofrequency energy.

1 22. A method as in claim 12, wherein the energy delivered comprises
2 thermal energy.

1 23. A method as in claim 22, wherein the thermal energy is radiated
2 radially outwardly from a thermal source in the esophageal lumen.

1 24. A method as in claim 23, wherein radiating thermal energy comprises
2 heating a radiator spaced radially inwardly from the mucosa to a temperature above 1000°C.

1 25. A method as in claim 24, wherein the radiator is selected from the
2 group consisting of filaments, spherical radiators, cylindrical radiators, and polygonal
3 radiators.

1 26. A method as in claim 24, wherein the radiator is positioned between
2 two expansible supports.

1 27. A method as in claim 24, wherein the radiator is positioned in a
2 balloon which is transparent to the radiated energy.

1 28. A system for treating mucosal tissue in an esophagus, said system
2 comprising:
3 an elongated member;
4 an energy delivery structure deployable from the elongated member and
5 adapted to deliver energy to at least a portion of a circumferential section of the mucosal
6 lining of the esophagus; and
7 means for delivering energy through the delivery structure under conditions
8 selected to initiate regrowth of a mucosal layer without substantial injury to a submucosal
9 layer underlying the mucosal layer.

1 29. A system as in claim 28, wherein the energy delivery structure
2 comprises an expandable structure deployable from the elongated member.

1 30. A system as in claim 29, wherein the expandable structure comprises
2 an expandable balloon.

1 31. A system as in claim 30, wherein the balloon is non-distensible and
2 dimensionally stable.

- 1 32. A system as in claim 30, wherein the balloon is elastic.
- 1 33. A system as in any of claims 28 to 32, wherein the energy delivery
2 structure further comprises an electrode array.
- 1 34. A system as in claim 33, wherein the electrode array comprises bipolar
2 electrode pairs formed over at least a portion of the outer surface of the balloon, wherein the
3 spacing between the electrodes is no more than 3 mm.
- 1 35. A system as in claim 34, wherein the electrodes are aligned axially on
2 the balloon.
- 1 36. A system as in claim 34, wherein the electrodes are aligned
2 circumferentially over the balloon.
- 1 37. A system as in claim 33, wherein the balloon includes electrodes of a
2 common polarity formed over at least a portion of its exterior surface.
- 1 38. A system as in claim 33, wherein the balloon includes electrodes of a
2 common polarity formed over at least a portion of its inner surface.
- 1 39. A system as in any of claims 30 to 32, wherein the balloon is inflatable
2 with a conductive medium to form a monopolar electrode.
- 1 40. A system as in claim 29, wherein the expandable structure comprises a
2 frame deployable from the elongated member and an electrode array formed over at least a
3 portion of the frame.
- 1 41. A system as in claim 40, wherein the frame comprises an arcuate
2 surface which carries the electrodes to engage a partial section of the circumference of the
3 esophagus.
- 1 42. A system as in claim 41, wherein the frame comprises two oppositely
2 facing arcuate surfaces.
- 1 43. A system as in claim 28, wherein the energy delivery structure
2 comprises a heating structure.

1 44. A system as in claim 43, wherein the heating structure comprises a
2 radiation heat source.

1 45. A system as in claim 44, wherein the energy delivery structure further
2 comprises a pair of expandable centering elements disposed distally and proximally of the
3 radiation heat source.

1 46. A system as in any one of claims 43 to 45, wherein the radiation heat
2 source is a filament, spherical radiator, cylindrical radiator, or polygonal radiator.

1 47. A system as in claim 28 wherein the energy delivery means comprises
2 a photonic source.

1 48. A system as in claim 28, wherein the energy delivery means comprises
2 a radiofrequency power supply.

1 49. A system as in claim 48, wherein the radiofrequency power supply is
2 adaptable to deliver an energy dosage in the range from 1 J/cm² to 50 J/cm² over a time
3 period less than 5 seconds.